

FIRE PROTECTION
FOR
ESSENTIAL ELECTRONIC
EQUIPMENT



RECOMMENDED PRACTICES NO. 1

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FEDERAL FIRE COUNCIL

Washington, D. C. 20405

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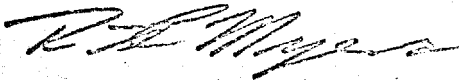
FOREWORD

The objectives of the Federal Fire Council are to reduce Federal life and property losses from fire through a cooperative effort of all Federal agencies coordinated through the Council; to promote and assist in the establishment of adequate fire safety programs and criteria in all Federal agencies; to encourage fire research for the purpose of better understanding the phenomena of fire; and to develop better techniques for fire control, suppression, and prevention.

At the Annual Meeting of the Council on January 26, 1960, a panel of four representatives from Federal agencies and Underwriters' Laboratories, Inc., discussed the topic "Fire Protection for Electronic Data Processing Installations". At a subsequent meeting of the Council on February 16, 1960, three representatives from the electronic computer industry formed a panel to discuss the topic "Industry Looks at Fire Protection for Electronic Data Processing Installations." (See Appendix A for a list of several significant fires involving electronic equipment.)

As a direct outgrowth of these meetings, a Subcommittee of the Design Standards Committee was formed to draft Recommended Practices for Fire Protection for Essential Electronic Equipment. This original Recommended Practices was known as RP-1.

The Brooks Act (PL 89-306) assigns both the General Services Administration and the National Bureau of Standards certain responsibilities and authorities with respect to Federal computer installation and equipment. As a result, the Office of Automatic Data Management Services of GSA has asked the Council to review and update RP-1 to assist it in developing guidelines relating to the procurement, operation, and safeguarding of data processing equipment. This document is a result of that effort and represents the Council's current thinking on fire protection for essential electronic equipment. This outstanding effort deserves our sincere thanks as it represents a large investment and effort on the part of the individual subcommittee members as well as Federal agencies they represent.



Chairman

This was a Computer



The revised edition was developed by a subcommittee operating through task groups with broad based representation of interested parties including architects, design engineers, electronic engineers, data processing specialists, records management specialists, and fire protection specialists. The final product was extensively reviewed and considered and where appropriate changed by the full Committee on Design Standards. The product as published herein represents the culmination of this effort. Some aspects of the previous edition were substantially revised. The broad base of representation on the task groups and the extensive review, however, are felt to assure that the revisions were not promiscuously made. The most important changes are considered to be the following:

a. The previous system of four classifications of combustibility interlocked with four classifications of importance has been deleted as idealistic but unworkable and replaced with machine construction standards that are reasonably obtainable and a simplified method of system or hardware importance classification.

b. A new section has been added to Chapter 3 on cable construction. The potential hazard of cable fires has been recognized. The data provided is considered the best currently available though not totally complete. It is hoped that future developments will allow improvement of the information on safe installation of cable.

c. The requirements for installed protection systems have been completely overhauled and revised. *SUGGESTS*

(1) The revised edition requires that all essential electronic equipment areas involving computers and other low energy devices shall be completely protected by automatic sprinkler systems. The inherent amount of combustibles built into the equipment, the character of the peripheral equipment, and the need for paper and other combustibles necessitates automatic extinguishing systems. Extensive review of fire control and potential damage from both fire and fire extinguishing actions has convinced the committee of the need of this requirement.

(2) Ionization type detection systems have been selected as the type of early warning detection to be provided when installed automatic fire detection is required or used.

(3) The previous recommendations for automatic carbon dioxide extinguishing systems have been eliminated.

(4) Readily available around-the-clock human response is required for all vital installations. Such capability is provided by the operators during their periods of presence.

(5) The previous requirements for automatic shutdown of air handling systems has been revised to encourage the use of smoke removal systems whenever practical.

d. A new paragraph has been added to the section on protection of records bringing attention and protection requirements to bear on memory devices.

e. A new section has been added in the coverage of salvage operation detailing the system for recovery from fire and water damage as developed by the U.S. Naval Research Laboratory.

The subcommittee invites comments on the document, pro or con. The subcommittee also invites recommendations for changes from any person. All comments, suggestions, criticisms, and recommendations for changes, should be addressed to the Federal Fire Council, Washington, D. C. 20405. The Federal Fire Council staff will insure that such are presented to the Subcommittee on Essential Electronic Equipment.

R. G. Bright
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Chairman, Subcommittee on
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101. SCOPE

101-1. This document applies to all essential electronic equipment.

101-2. Electronic equipment includes all equipment and devices which are electrically powered and use the emission of electrons in vacuum tubes, cathode ray tubes, photo-electric cells, transistors, diodes, integrated circuits and other solid state devices to accomplish a result. This includes, but is not limited to, electronic digital and analog computers, radio and television equipment, electronic sorting equipment, facsimile transmitting equipment and other electronic equipment used for statistical, communication, process control, measurement, guidance or supervision operations. For the purpose of this document, particle acceleration machines, such as cyclotrons, synchrotrons, and betatrons, presents special additional problems and as a result must be considered individually by a competent fire protection engineer to determine additional requirements necessary.

101-3. Essential equipment includes that which meets one or more of the following criteria:

- a. Is designated as essential, critical, vital, or important by the agency involved.
- b. Is necessary to the safety of persons.
- c. Is essential to the security or health of the Nation.
- d. Performs an operation which must be continued to completion without interruption.
- e. Performs an operation which could be performed by substitute methods but where the substitute methods would involve significant additional expenditures for personnel, facilities and/or equipment.
- f. Has a high monetary value to the Federal Government.

Note: Value is a measure of the monetary investment involved in equipment and is expressed as such. Some portions of electronic equipment and systems are extremely valuable. Any unit of electronic equipment which represents a high value shall be considered essential. The determination of what constitutes high value rests with the agency which would suffer monetary loss in case of fire.

101-4. In making appraisals of electronic equipment in accordance with paragraph 101-3 above, consideration shall be given to the time lag and costs involved in obtaining replacements, the availability of alternate facilities and the complexity of the equipment. Consideration of the availability of alternate facilities shall include an investigation of the primary use and mission requirements of the alternate equipment to guarantee its availability in the time of need.

201. GENERAL.

201-1. Historically, many of the losses experienced in essential electronic equipment have been due to situations and surroundings external to the equipment installation itself. Chapter II is designed to provide a firesafe environment for essential electronic equipment.

201-2. The structure in which essential electronic equipment is housed shall be so located, constructed and/or protected to provide the least possible danger of fire, water, and smoke damage to the equipment.

201-3. Essential electronic equipment may be located in new or existing structures. In multi-story structures the equipment may be located on any floor including basement, mezzanine, and penthouse. When locating essential electronic equipment in basements or other areas below the building grade level, special consideration should be given to protecting the electronic equipment from water that would tend to run to the lowest portion of the building as a result of fire fighting efforts elsewhere in the structure.

202. HOUSING STRUCTURE.

202-1. The requirements in Section 202 are designed to provide a safe housing structure and eliminate the danger of a fire, not related to the electronic equipment, but which may damage or destroy such equipment. Housing structure means a combination of materials to form a construction that is safe and stable; including among others, buildings, sheds, shelters, and stadiums.

202-2. When essential electronic equipment is housed in a portion of a structure, either new or existing, and that portion is subdivided from the remainder of the structure by fire walls, then only the portion of the structure housing the equipment shall comply with this section.

202-3. Existing structures used to house essential electronic equipment shall be either fire-resistive or noncombustible construction. Where deviation is of paramount necessity an existing structure of combustible construction may be used to house essential electronic equipment, provided the structure is completely protected by an automatic sprinkler system complying with all requirements of National Fire Protection Association Standard No. 13, "Sprinkler Systems".

202-4. New structures built to house essential electronic equipment shall be of fire-resistive or noncombustible construction. All structural members of noncombustible construction, including walls, columns, piers, beams, girders, trusses, floors, and roofs, shall be of materials which are inherently noncombustible such as steel, iron, aluminum, brick, concrete, glass, ceramic tile, slag, asbestos, plaster, etc., as opposed to materials which are inherently combustible but have been treated to give them fire-retardant qualities. Materials used for interior finishes, insulation, vapor barriers, or acoustical treatments shall meet one of the following criteria of noncombustibility:

a. Materials no part of which will ignite and burn when subjected to fire. The American Society for Testing Materials Standard E-136, "Determining Noncombustibility of Elementary Materials", shall be used as the criterion for determining noncombustibility within the meaning of this subparagraph.

b. Materials other than as described in paragraph a above, having a surface flame-spread rating not higher than 25 without evidence of continued progressive combustion.

Note: Flame spread, smoke generation, and fuel contribution ratings as used herein refer to ratings obtained according to National Fire Protection Standard No. 255, "Tests of Surface Burning Characteristics of Building Materials," and American Society for Testing Materials Standard ASTM E84, "Surface Burning Characteristics of Building Material."

202-5. When essential electronic equipment is to be housed in new or existing structures containing other occupancies, the following factors shall be considered to assure that the electronic equipment is not susceptible to danger as a result of fires in the other occupancies:

a. In single story structures, equipment areas shall be separated from other occupancies by fire-rated walls or partitions (See Section 203 for fire-resistance ratings of these separating walls and partitions). The structure's framing system shall be designed so that a fire external to the electronic equipment area cannot cause a structural failure which will cause damage or structural collapse within the electronic equipment area.

*As used in this document ASTM E-136 is applicable to composites as well as elementary building materials.

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b. In ~~existing structures, equipment areas and other occupancies by fire-rated walls or partitions, floor or roof and ceiling construction.~~ The structure's framing system shall be designed so that a fire external to the electronic equipment area cannot cause a structural failure which will cause damage, or structural collapse within the electronic equipment area.

c. Utilities shall be laid out as required in Chapter IV.

d. The floor above electronic equipment shall be provided with reasonable protection to prevent passage of accidental spill, wash water, or other leakage. In any case, where there is a large quantity of water or a high potential of water spill or flow other than that which might result from fire fighting operations, on a floor above an electronic equipment area, a complete waterproof membrane should be provided. Where any serious potential of water spillage exists on the floor within the electronic equipment area, the necessary curbs, sills, and floor drains should be provided.

e. Automatic sprinkler protection shall be provided for all high hazard occupancies and for any moderate hazard occupancy not separated from the electronic equipment area by fire-resistive construction having at least a 2-hour fire-resistive rating. (See Appendix B, Fire Hazard Classification of Occupancies).

202-6. When the essential electronic equipment area has one or more exterior walls, protection against exterior fire exposure shall be provided as needed.

203. PERIMETER SEPARATION FOR ELECTRONIC EQUIPMENT AREA.

203-1. The requirements in Section 203 apply to single and multi-story structures and are designed to provide a fire-resistive separation between the electronic equipment area and adjoining areas including those located above and below other adjacent, contiguous or abutting structures, yard storage, and industrial operations. The prime purpose of the perimeter separation is to protect the essential electronic equipment from the damaging effects of a fire outside of the essential equipment area.

203-2. Fire-resistive separations shall be of a noncombustible material having a fire resistance classification not less than the maximum fire potential of occupancies in adjoining areas or other adjacent, contiguous or abutting structures, yard storage and industrial operations (See Appendix B to determine the maximum fire potential). In no case shall the fire resistance classification be less than 1-hour.

203-3. Fire-resistive separations shall extend from structural floor to the under side of the structural floor or roof above. In existing structures of combustible construction, fire-resistive separations having a fire-resistive classification of 2-hours or greater should preferably start at the foundation and extend continuously through all stories to and above the roof to form a parapet.

203-4. Openings in fire-resistive separations shall be protected by fire doors, fire windows, fire dampers, or glass block; subject to the following limitations:

a. Fire windows or fire resisting glass block meeting the requirements of paragraph 203-8, may only be used for openings which are subject to light fire exposure and which are protected by automatic sprinklers.

b. Fire dampers having a fire-resistance rating of at least 1-1/2-hours shall be used in ducts where required in Chapter IV, Utilities.

c. Fire doors meeting the fire-resistance ratings prescribed in paragraph 203-7 shall be used on any door openings in the separation.

d. Fire doors serving as exit doors must swing with the exit travel except for doors on individual small rooms which may swing in. Rolling steel doors and jack-knife doors shall not be used on exits. Normally closed sliding fire doors shall not be used on exits. Where desired, two doors may be installed on opposite sides of the wall, one an automatic, horizontally-sliding fire door, normally open, and the other a self-closing, smoke stop door, not necessarily a fire door, swinging with the exit travel and normally closed.

e. Because of the potential of smoke damage, all openings in the separation, except ducts, should be protected with normally-closed doors, fixed fire windows, or glass block. (Electronic equipment areas are normally operated under positive pressure.)

203-5. Fire protection ratings of fire doors, fire dampers, fire windows, and fire-resisting glass block shall be as determined and reported by a nationally recognized testing agency in accordance with "Methods of Fire Tests of Door Assemblies", NFPA No. 252, UL 10(b), or ASTM E152.

203-6. Installation including size limitations and hardware of fire doors, fire windows, and glass blocks shall be in accordance with the requirements of NFPA No. 80, "Fire Doors and Windows".

203-7. Fire-resistance classification of fire doors shall be in accordance with the following table:

Fire-Resistance Classification of Perimeter Separation	Minimum Fire-Resistance Classification of Fire Doors for Openings
More than 2 hours.	3 Hr. (A) with Temp Rise - 30 Min. - 650°F Max.
2 hours	1-1/2 Hr. (B) with Temp Rise - 30 Min. - 650°F Max.
Less than 2 hours	1-1/2 Hr. (B) or (D) or 1 Hr. (B) with Temp Rise - 30 Min. - 650°F Max.
1 hour	3/4 Hr. (C) or (E)

203-8. Fire windows shall be listed windows with the label on the window frames, which read, "Inspected Fire Window" (approved for moderate or light fire exposure) or "Inspected Fire Window Frame for Light Exposure." Only listed glass blocks shall be used.

203-9. Viewing windows and special architectural treatments for entrance doors may be provided in the separation provided they do not violate the fire integrity of the separation. Some methods of accomplishing this are:

- The use of double sets of doors; one set of normally closed architecturally desirable doors of any construction, and a second set of swinging or sliding fire doors held in the open position by fusible links or other automatic fire detection devices. The fire doors may, if desired, be concealed. In such installation, the swing of the architectural doors shall not interfere with the operation of the fire doors.
- When the fire exposure in the adjacent portions of the building is light and automatic sprinkler protected, a fire window assembly may be used for a viewing window.
- When extending the electronic equipment area to include a low fire hazard corridor, conference room, or similar area and installing the viewing window between this room or corridor and the electronic equipment, The requirements for fire-resistive cutoffs and fire doors or other protection for openings will then apply to the entire area included in the electronic equipment area.
- Limiting the viewing windows to the size of the fire doors and providing automatic fire door protection for such viewing windows.

203-10. The total area of all openings in a fire-resistive separation shall not exceed twenty-five percent of the total surface area from finish floor to finish ceiling of that separation in any plane or elevation.

204. INTERIOR CONSTRUCTION OF ELECTRONIC EQUIPMENT AREA.

204-1. The requirements in Section 204 are designed to produce an electronic equipment area that will not in itself provide the fuel for a disastrous fire.

204-2. When areas in an existing structure are to be converted for use as electronic equipment areas, all nonstructural combustible materials within the perimeter separations of the equipment areas shall be removed, except as permitted in paragraphs 204-3 and 204-5 below.

204-3. All materials installed within the perimeter separations of the electronic equipment areas including those used for walls, partitions, raised floors and their supporting systems, wall finishes, suspended ceilings and their suspension systems, insulations or sound deadening boards, vapor barriers, acoustical treatments, furring strips, battens, ductwork, and other constructions shall be noncombustible, except that minimum amounts of exposed wood moldings and trim are permitted.

204-4. When raised floor systems are used in electronic equipment areas, they shall be of concrete, steel, aluminum, or other noncombustible materials, except that minimum amounts of vinyl or rubber materials are permitted for leveling, sealing, etc., or to prevent horizontal shifting of floor panels or decking.

a. Flooring, decking, ramps shall be concrete, steel, minimum, or other noncombustible materials.

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b. Flooring or decking shall consist of easily removable access panels or sections provided in sufficient quantities so that power and signal cables, wiring and all space beneath the raised flooring or decking is accessible in case of emergency.

c. Joints around floor panels or sections and openings in the flooring or decking for cables, wiring or other uses shall be protected to minimize the entrance of debris or other combustibles beneath the flooring or decking. This may be accomplished by noncombustible covers, grilles, screens, gaskets, or by locating equipment directly over the openings or joints. Cable and wire openings shall be made smooth or shall be otherwise protected to preclude the possibility of damage to the cables or wiring.

d. Fascia or closure plates, which form side walls for ramps or edges of the flooring system, and handrails shall be of noncombustible materials.

e. Commonly used floor covering materials, such as resilient floor tile may be used on the raised floor deck.

204-5. When a raised floor system is to be installed in an area having combustible finish flooring or floor covering, an insulating noncombustible material shall be installed over the flooring or floor covering.

204-6. If the structural floor in the electronic equipment area is lower than the adjacent structural floor, it should be equipped with an adequate drainage system. Provide backwater valves if there is any danger of water backing up through the system.

204-7. Floor or roof construction above electronic equipment areas shall be made as resistant to water leakage as practicable. Expansion joints should be flashed and/or otherwise protected.

204-8. When the concealed space formed by a ceiling and floor or roof above is used as a supply or return air plenum chamber, the ceiling and the plenum chamber installation shall conform with the appropriate provisions in NFPA No. 90A, "Air Conditioning and Ventilating Systems".

204-9. Noncombustible fire stops equivalent to 24-gauge galvanized sheet metal shall be installed in the concealed spaces formed by a raised floor and floor below, or by a ceiling and floor or roof above to subdivide the space into compartments not exceeding 10,000 square feet or 100 linear feet in any direction.

204-10. Ceilings shall be provided with access doors, panels, hatches, or other means of ready access to all portions of the concealed space above. In fire-resistive ceilings, access panels shall be of construction equivalent in fire resistance to the ceiling ratings.

204-11. Fire-resistant separations between separate essential electronic systems shall be of noncombustible material having a fire-resistance classification greater than the maximum fire potential of either essential electronic system. In no case shall the fire resistance be less than 1 hour. Any openings in the fire-resistant separations between the systems shall have equivalent fire-rated protection. This fire-resistant separation shall extend from ceiling slab to the floor slab to include any concealed spaces above the ceiling and below the floor. When two or more adjacent systems are protected by automatic sprinklers in accordance with paragraph 305, the separation may be of any noncombustible material with or without fire resistive rating.

205. PROTECTION SYSTEMS FOR ELECTRONIC EQUIPMENT AREAS.

205-1. Fire detection and fire extinguishing systems shall be provided as required in Chapter III

206. OPERATING ENVIRONMENT FOR ELECTRONIC EQUIPMENT AREA.

206-1. The requirements of this paragraph are designed to reduce the amount of combustibles permitted within the electronic equipment area, thereby reducing the possibility of fire and the severity of any fire which may occur.

206-2. Except as noted below, only the actual essential electronic equipment and auxiliary equipment electronically interconnected with it or which must be located in close proximity to the essential electronic equipment shall be permitted in the electronic equipment area.

206-3. Metal ~~Approved For Release 2002/05/16 : CIA-RDP78-06501A000300010030-4~~ may be located within the electronic equipment area.

206-4. Small size supervisory office areas and similar light hazard occupancies directly related to the electronic equipment operations may be located within the electronic equipment area, provided that all furnishings are metal and adequate facilities are provided for containing the necessary combustible materials. Supplies of paper or other combustible materials shall be strictly limited to that needed for efficient operation.

206-5. Records may be kept in the electronic equipment area to the extent allowed in Chapter V.

206-6. The following are prohibited in the electronic equipment area:

a. Any activity or occupancy not directly associated with the electronic system(s) involved.

b. Storage of office supplies, forms, stationery and other combustible supplies.

c. Components of the electronic equipment operation which are neither electronically interconnected to the essential electronic equipment or required in close proximity and either:

(1) Involve the presence of large quantities of paper or other combustible material, or

(2) Contain significant amounts of combustible material such as wire insulation, combustible housing, etc., or

(3) Are in themselves critical to the operation and would require a long lead-time to replace. (Such equipment shall be contained in a fire-resistive cut off area of its own with such fire protection as is appropriate.)

d. Maintenance shops and maintenance operations except for those repair and maintenance operations which must be performed directly on equipment which is impractical to remove from the electronic equipment area.

e. Bulk storage of records (See Chapter V).

f. Any other combustible material, equipment or operation which constitutes a hazard and which can be removed.

CHAPTER III - MACHINES AND CABLES

301. SCOPE.

301-1. It is the intention of this section to include all essential electronic equipment characterized as low energy devices; for example, digital computation and telephone communications equipment. Though this section is primarily applicable to low energy equipment, application of these principles for high energy equipment will of necessity require individual study and consideration to evaluate the necessary construction, detection, and protection standards applicable to the level of risk and importance involved.

301-2. In view of the use of combustible materials, particularly plastics for wire insulation, printed circuit boards, and other components as well as the necessary internal configurations of electronic equipment, it is evident that all essential equipment can under normal operating conditions support combustion to a degree sufficient to cause serious internal damage. Review and examination of electronic equipment, the history of fires in such equipment, and those combustible materials (insulations, dielectrics, mountings, printed circuit boards, etc.) essential to equipment design shows that once started, combustion may continue until extinguished or until it totally damages the compartment of origin with potential for spreading to other compartments. It is the intent of these requirements to mitigate fire development and propagation by reasonable criteria that will limit the amount of combustible material and provide barriers against fire propagation within or out of electronic equipment to the degree consistent with the operating needs of the equipment. As a consequence, specific combustibility classifications are not assigned to essential electronic equipment. Any equipment not conforming to the recommendations of this chapter, however, may present risks to itself and/or to neighboring elements greater than that which is necessary or should be tolerated.

Note: Underwriters' Laboratories, Inc., has published a Standard for Safety for "Electronic Data Processing Units (UL 478-1967)". UL 478 represents the judgment of Underwriters' Laboratories, Inc., in defining the construction and test standards to determine equipment so constructed that when de-energized, fire is not likely to spread beyond the external housing of the unit in which the source of ignition is located. A unit is defined by UL as that portion of a system to which identification number is applied. The requirements of UL 478 are incorporated in this recommended practice; however, it is the judgment of the subcommittee that a single unit as defined by UL frequently represents an excessive module of risk and, therefore, requirements in addition to the requirements of UL 478 are included to provide the Government with equipment where a fire is less likely to involve an entire unit.

302. CLASSIFICATION OF SYSTEMS OR HARDWARE.

302-1. Assuming the system meets the criteria for essentiality as defined in paragraph 101-3, and thus falls within the scope of this Recommended Practice, the system or hardware shall be classified by functional importance as either vital or important in accordance with 302-2 below. Subsystems or devices within the system shall be classified relative to their functional importance to the overall system. In no case should a subsystem or device receive a higher classification than the system as a whole.

302-2. Classifications:

a. Vital - a system or hardware that is essential to operations and is irreplaceable or the delay in replacement would constitute a serious loss involving the safety of persons, the security of the Nation, an important mission or function of the agency involved, or a major economic loss.

b. Important - a system or hardware that is essential to operations, but could with difficulty or extra expense be replaced or substituted for, without a critical delay.

303. MACHINE CONSTRUCTION.

303-1. The requirements contained in Section 303 are designed to provide the Federal Government with electronic equipment which, to the maximum extent practical, will not sustain or propagate a fire originating from electrical defects or overheating within the equipment or from a small exposure fire outside of the equipment. The possibility of ignition from large exposure fire sources is not considered since it must be expected that the heat from any such fire would destroy the equipment whether or not the equipment became involved. With the realization that it will not always be practical or even possible to provide equipment which will not support combustion, the following requirements provide for various means of reducing the possibility of fire and limiting the amount of damage which can result from fire. Approved For Release 2002/05/16 : CIA-RDP78-06501A000300010030-4 subdivision, compartmentation, and other safeguards.

303-2. Except as modified below, all electronic data processing units and systems that are part of an electronic computer or similar essential electronic equipment shall conform to the requirements of UL Standard 478-1967, "Electronic Data Processing Units and Systems". All other electronic equipment shall conform to the requirements given below and any appropriate and applicable provisions of UL 478.

303-3. Noncombustible material shall be used in the construction of essential electronic equipment. All structural members; i.e., cabinets, frames, chassis, supports, partitions, etc., shall be noncombustible. In addition, all non-structural items such as shields, covers, and guards shall be noncombustible.

Note: Noncombustible is defined as in paragraph 202-4a as follows: "Materials no part of which will ignite and burn when subjected to fire." The American Society for Testing and Materials Standard E136, "Determining Non-Combustibility of Elementary Materials," shall be used as the criterion for determining noncombustibility within the meaning of this subparagraph.

303-4. To the maximum extent possible, noncombustible materials shall be used for electrical insulation, electrical components, component mountings, and printed circuit boards. When it is impossible or impractical to use noncombustible materials, the materials used should be the least combustible available that will meet the operating needs of the equipment. When combustible components are used, additional protection of equipment may be necessary.

303-5. Bulkheads and other forms of subdivision and compartmentation of a construction adequate to stop or at least impede the progress of a fire shall be used to the maximum extent possible.

303-6. Filters shall comply with Underwriters' Laboratories, Inc., Class I and shall be replaceable and be changed at sufficient frequency to prevent accumulations of hazardous amounts of combustible dust or lint.

303-7. If any oil immersed equipment is used, the oil should be askarel (nonflammable dielectric medium) as defined by NFPA No. 70, "National Electrical Code". Sealed or other closed vessels containing liquids shall be provided with emergency relief adequate to prevent pressure rupture in case of fire exposure.

303-8. Foamed plastics or foamed rubber shall not be used for sound or thermal insulation, padding, blocking of openings, or any other use in machine construction. This restriction applies to both the ordinary types and those types identified as self-extinguishing, slow-burning, or non-burning.

303-9. When special fixed fire protection systems are necessary, they shall, whenever possible, be specified as part of the purchase, leasing contract or design, and shall be installed as an integral part of the equipment. Such systems include, but are not limited to, detection and extinguishing systems.

304. CABLE CONSTRUCTION.

304-1. Cabling is defined as being those power supply and signal conductors which connect to the units, between the units, and between major subdivisions as opposed to those conductors which are internal to the units. Specifically, a cable passing through an equipment cabinet wall shall be identified as cable when external to the cabinet, but may be identified as internal wiring when it is within the cabinet.

304-2. Signal carrying cables and power conductors should be physically separate except that interconnecting cable may carry both power and signal when specifically designed for this service and specifically approved by a recognized testing laboratory for the services involved. The separation between power and signal cables should be sufficient so that a fire developing in one group shall in no way affect the operation of the other group. To the greatest extent possible, a noncombustible fire stop is recommended between power cable groups.

304-3. In any case where cables are supported by racks, trays, or other supports, the entire support system shall be of noncombustible construction.

304-4. It should be recognized that cables may burn vigorously when in groups. The grouping of cables should be avoided to the maximum extent possible. In congested areas such as cable tunnels, special protection may be needed due to the difficulty in locating and approaching a fire.

304-5. Cables whose insulation has been treated to minimize the development and propagation of fire, which can be identified as flame retardant and those which have been tested and accepted by recognized testing laboratories, are preferred and recommended for use in conjunction with essential electronic equipment. Their use will reduce but not eliminate the fire hazard from cable groups referenced in paragraph 4 above.

305. FIRE PROTECTION COMPONENTS.

305-1. This section describes four fire protection systems that may be employed for essential electronic equipment protection. The following section 306 describes the conditions under which one or more of the fire protection systems will be required.

305-2. Automatic Sprinkler Equipment:

a. Automatic sprinkler protection for essential electronic equipment areas shall be in accordance with NFPA No. 13, "Sprinkler Systems". Each automatic sprinkler system shall be provided with both local and automatically transmitted water flow alarm. The sprinkler system should preferably be valved independently from other sprinkler systems.

b. It is not the intent of this recommended practice to require sprinklers under normal shallow raised floor areas. In a situation where a raised floor encloses larger volumes, is greater in depth, includes extensive cable runs, allows for the possible accumulation of combustibles, etc., special consideration should be given to the inclusion of sprinklers.

305-3. Automatic Fire Detection Equipment:

a. When required, automatic fire detection equipment capable of detecting fire in the incipient stage shall be installed. The equipment used shall be the product-of-combustion (ionization) type. Installation shall be in accordance with current NFPA standards for equipment of this type. Each installation shall be engineered for the area to be protected giving due consideration to air currents and patterns within the space, under floor areas, false ceiling spaces, cable ways and tunnels and return air ducts connected directly to equipment. Consideration also should be given to establishing a specific performance objective for the fire detection equipment, such as detection of a certain size and type of fire within a fixed period of time. When a performance objective is specified, it shall also be specified that the equipment must not give false alarms with the sensitive setting necessary to meet the performance objective. In the instance where a fire detection system is included with an installation, the detection system shall sound an alarm in the area. When a fire alarm system is in use, it shall be used to transmit the electronic equipment area alarm to a constantly supervised location.

(1) Detection equipment should be arranged to shut down all power and air conditioning to the involved equipment, except where air handling equipment is specifically designed for smoke removal.

Note: Shutdown of all power and air conditioning will not always be possible as this feature requires precise zoning of the detection equipment. It may be better to use the detection equipment to shut down power to all equipment in the area. Again, with the air conditioning, it may be better to keep the air conditioning running to clear out the smoke using the detection equipment if possible to convert the air conditioning from recirculation to total fresh air supply and total exhaust. There has been a fear that the air conditioning system will supply fresh oxygen to the fire. However, there is sufficient oxygen already in the room to feed the largest fire likely to occur, thus reducing the importance of this fear.

305-4. Portable Fire Fighting Equipment:

a. The requirements of this paragraph are designed to provide fire extinguishers which will be immediately available and capable of controlling incipient fires in the electronic equipment area. Carbon dioxide fire extinguishers or hose reel systems are recommended for the energized electrical aspects of the problems. No other Class C (electrically nonconducting) extinguishing agents should be used. Plain water-type fire extinguishers are required in addition to the carbon dioxide extinguishers because of the inevitable presence of ordinary combustibles (paper, wood, cloth, plastics, etc.) in the form of records, logs, work sheets, interior finish or decorations, etc.

b. Every electronic area shall be provided with carbon dioxide fire extinguishers, prominently located so that no electrically powered machine or other electrical equipment is more than 50 feet travel distance from a carbon dioxide fire extinguisher of at least 15 pound capacity.

c. Each electronic equipment area shall be provided with plain water fire extinguishers, prominently located so that no person working in the electronic equipment area shall have to travel more than 50 feet to obtain a fire extinguisher having a capacity of at least 2-1/2 gallons.

d. All fire extinguishers shall be properly maintained, charged, and in good working order. Fire extinguishers shall not be blocked or located so that a small fire may block the approach to the fire extinguisher.

306. DESIGN OF THE FIRE PROTECTION SYSTEM.

306-1. The preceding section (305) described various fire protection equipment which is applicable for use upon essential electronic systems. This section will focus itself upon the types of fire protection systems required for the two classifications of essential electronic systems.

306-2. Vital Systems. All vital electronic systems shall be protected with the following combination of fire protection equipment.

a. Automatic Sprinklers. Automatic sprinkler protection (per paragraph 305-2) shall be provided for the entire electronic equipment area. The purpose of sprinkler protection is to limit and control major fire incidents and prevent total destruction of the electronic system. Sprinkler protection does not provide the first line of defense, but is included to prevent an incident which may progress beyond control from developing into a major disaster involving total destruction of all equipment in the area.

b. Automatic Detection. Automatic detection (per paragraph 305-3) shall be provided for the entire electronic equipment area. This shall be in addition to any human supervision that may be present. While human supervision is considered satisfactory for fire detection involving only important electronic equipment, such total dependence on human senses for fire detection is considered to involve a degree of risk due to the variations in human olfactory sensitivity.

c. Manned Response. Adequate personnel shall be available in or adjacent to the electronic equipment area on a 24 hour-a-day basis to respond to any alarm with effective first aid firefighting. The respondents shall be familiar with the equipment and utility supply layout and thoroughly trained in first aid fire suppression and in system operation, access, and shut-down. The intent is to provide immediately a maximum reasonable fire suppression effort pending the arrival of professional firefighting personnel and equipment.

d. Portable Fire Fighting Equipment. Portable fire fighting equipment shall be provided (per paragraph 305-4).

306-3. Important Systems. All important electronic systems shall be protected with the following combination of fire protection equipment.

a. Automatic Sprinklers. Automatic sprinkler protection (per paragraph 305-2) shall be provided for the entire electronic equipment area. Sprinklers are installed to limit and control major fire incidents and prevent total destruction of the installed units.

b. Automatic Detection. Automatic detection (per paragraph 305-3) shall be provided for the electronic equipment area.

(1) In the event that important equipment is unattended, whether operating or non operating, and no reasonably quick and effective manned response is available automatic ionization type detection equipment may be omitted. In such cases the sprinkler system will be relied upon for both fire detection and suppression any time the equipment is unattended.

(2) If important equipment being protected is, during all periods when it is energized, under the constant supervision of an operator or other person familiar with the equipment, the human supervision may be considered as satisfying the requirements of fire detection. In such case, easily accessible controls shall be provided to shut down power and air conditioning equipment involved. This may be a master control switch or a separate switch to control a single unit.

c. Portable Fire Fighting Equipment. Portable fire fighting equipment shall be provided (per paragraph 305-4). These extinguishers provide the fire protection equipment for first line defense when manned response is available.

307. COMBINATION OF ELECTRONIC SYSTEMS.

307-1. This section is concerned with the prevention of a multiple disaster which destroys or causes serious damage to more than one system of electronic equipment.

307-2. Normally, separate essential electronic systems shall not be combined in a single fire area. Separate systems shall not be located in the same fire area solely because they work on similar problems, are assigned to a single operating unit, or are under common management. Separate electronic equipment operations, may however, be located in adjacent fire areas with properly protected communicating openings in the separating wall.

307-3. In special cases when it is necessary to locate more than one essential electronic system in a single fire area, judgment shall be exercised to provide the best possible separation of systems and of other essential equipment.

307-4. When multiple electronic systems are installed in the same fire area, the fire area shall be characterized by the highest classification of equipment installed: i.e., if a "vital" system is installed in a given area, then the entire area and all included equipment regardless of classification shall be subject to the same fire protection criteria. Design of the fire protection system shall then take into account the nature and quantity of the equipment installed as well as the important classification.

308. TRAINING.

308-1. It is of cardinal importance that all personnel involved in the operation of essential electronic equipment be thoroughly trained in the use of all the fire fighting equipment available within or adjacent to the operating area. Furthermore, the personnel should all be thoroughly familiar with the electronic systems protection procedure requirements in the event of a fire in addition to the capabilities and limitations of the fire fighting equipment available to them.

308-2. After initial training and orientation with the fire protection and detection systems used within the operating area, all personnel shall attend semiannual refresher training sessions designed to update their knowledge of the equipment and procedures to be used in the event of a fire.

CHAPTER IV - UTILITIES

401. AIR CONDITIONING SYSTEMS.

401-1. Air conditioning systems shall conform to the requirements of NFPA No. 90A, "Air Conditioning and Ventilating Systems", and to the additional requirements set forth below.

401-2. When air conditioning is provided for the electronic equipment, the air distribution system for the area involved and associated rooms and repair areas shall be completely separate and independent from any other air distribution system. The refrigeration compressors, brine circulation system, cooling towers, or similar equipment may, however, be common to other systems if desired.

a. The requirements of paragraph 401-2 may be modified if the design of the air distribution system positively prohibits the spread of fire, smoke, fumes, etc., from exposing areas into the electronic equipment area. In such cases, fire dampers or fire doors shall be provided to maintain the fire integrity of the equipment area enclosure. (See sections 203-4, 203-5, 203-6, and 203-7 and the National Fire Protection Association Pamphlet No. 90A).

401-3. All duct insulation and linings, including vapor barriers and coatings, shall be noncombustible. (See paragraph 202-4).

401-4. All filters shall be noncombustible (meeting the requirements for Underwriters' Laboratories, Inc., Class I or better) and cleaned or replaced as necessary to prevent combustible dust or lint accumulations.

401-5. Air ducts serving other areas should not pass through the electronic equipment area. When it is impractical to reroute such ducts, they shall be encased in a fire-resistive duct, equivalent to the fire resistance of the enclosure for the electronic equipment area. Such ducts shall not pass through any special records storage vault or room.

402. ELECTRICAL SERVICE.

402-1. The requirements in this section apply to all power and service wiring supplying the electronic equipment area and the equipment. The equipment and interconnected wiring requirements are set forth in Chapter III.

402-2. All wiring shall conform to NFPA No. 70, "National Electrical Code". Wiring to electronic equipment shall be flame retardant and if run under raised floors, it shall also be water resistant. Communication or other wiring of similar nature under raised floors shall be separated from lighting or power circuit wiring as required by Article 800-3 of NFPA No. 70. If the space below the raised floor is used as a plenum chamber, the installation shall conform to the requirements of Article 300-22. Bundling or stacking of cables in large groups should be avoided. Abandoned wire shall be removed from the under floor space.

402-3. Service Transformers should not be permitted in the electronic equipment area. However, if such a transformer must be installed in this area, it shall be of the dry type or the type filled with an Underwriters' Laboratories, Inc., listed Nonflammable Dielectric Medium. Such transformers shall be installed in accordance with the requirements of the National Electrical Code.

402-4. Junction boxes under raised floor areas are to be avoided. If they must be used, they shall be metal, completely enclosed, readily accessible, grounded to the electrical equipment ground, and in compliance with the National Electrical Code requirements as to construction. They shall be securely fastened to the floor. No splices or connections shall be made in the underfloor area except within junction boxes, or by means of receptacles or connectors which incorporate grounding wires and which have positive means to prevent accidental disconnection or loosening.

403. EMERGENCY POWER CONTROLS.

403-1. A prominently labeled master control switch(s) shall be located at each principal entrance to the electronic equipment area immediately within the entrance. These switches shall disconnect power to all electronic equipment. These master control switches shall be in addition to any emergency shutdown for individual machines or other units of equipment.

501. GENERAL STORAGE.

501-1. Section 501 concerns reducing fuel for fire by prohibiting the storage of all combustible supplies and materials not needed to accomplish day-to-day operations.

501-2. Of necessity, the operation of electronic equipment involves storage of sizeable quantities of combustible materials. Print-out paper, stationery supplies, unused magnetic and paper tapes, packaging materials and other types of flammable supplies are customarily stored. If not rigorously controlled, the storage of these items may become a serious fire hazard. An accumulation of supplies should be clearly recognized as fuel load for potential fires which might damage costly computer hardware and destroy valuable records.

501-3. Within the electronic equipment area the storage of all combustible supplies shall be restricted to the minimum level required for efficient day-to-day operations, and these materials shall be kept in totally enclosed metal containers or file cabinets.

501-4. Storage rooms outside the electronic equipment area shall be provided for reserve stocks of supplies, including paper, unused magnetic tapes and other items required for continuing operations.

502. PROTECTION OF RECORDS.

502-1. Section 502 details requirements for protecting various types of records involved in the use of electronic equipment, and methods for protecting the different recording media used. Requirements for protection of records on paper-based materials are derived from extensive experience with paper in fire situations and long-established standards. On the contrary, protection needs of records on plastic-based materials are determined by more limited experience and knowledge. Yet it is known that plastic-based materials are more susceptible to fire damage than paper-based records. Protection methods, sufficient to safeguard paper records, are less than adequate for plastic-based materials.

502-2. General. Some electronic installations involve the creation, use and storage of large quantities of input records as well as print-out records. These records in some instances can be more important to continuity of operations than the electronic equipment itself.

502-3. Record Media. Typical input recording media include punch cards, plastic- or metal-based electronic tapes (on metal or plastic reels and in metal, plastic or cardboard containers); paper or plastic punch tapes; microfilm and other photographic media; control panels, magnetic disks, memory drums, memory cores, and other media usually in machine language format.

502-4. The degree of protection provided records shall be directly related to their importance. In this context, importance will be measured by an evaluation of what the loss of a particular record would mean in terms of accomplishing the mission of an electronic system, and the reestablishment of operations after a fire. To maintain a reasonable sense of consistency, it should be assumed that electronic equipment capable of properly processing input records will be available. The following method for categorizing all records, based on their relative importance to the established mission, adopted from NFPA No. 232, "Protection of Records" shall be used. This method prescribes that all records shall be evaluated and assigned to one of four general classes. It simplifies the problem of safeguarding, assuring adequate protection is provided where required and superior protection is not used unless warranted. The four general classes of records are:

a. Class 1 (Vital Records). Records essential to the mission which could not be quickly reproduced or obtained elsewhere. Examples include indispensable program records, master records, accounts receivable, specified wiring diagrams, and various types of operational data. Examples also may include emergency operating and rights and interests records designated by an agency for use with the National Emergency Preparedness Program.

b. Class 2 (Important Records). Records possessing a high value to the mission but which, if lost, could be reproduced or reconstructed with difficulty or extra expense. Loss of records in this class would cause a considerable delay in execution of the mission. Examples include statistical records maintained to check operating costs, manpower and material utilization, designs in process of development, and records of experiments in progress.

c. Class 3 (Useful Records). Records which could be readily replaced without presenting an insurmountable obstacle to prompt restoration of operations. Examples might include program records contributing to accomplishment of mission but possessing less than a high value, and procedural instructions for use as examples in solving special problems.

d. Class 4 (Nonessential Records). Records which upon examination are found unnecessary to accomplishment of the mission, and records which in accordance with prearranged plans and authorizations are eligible for destruction, or erasure of recorded data on magnetic media.

502-5. Memory Devices. Memory devices involve a wide range of configurations designed to store specific kinds of data in a computer assembly. Each memory device must store data in an arrangement compatible with the computer in use. Protection of a memory device therefore concerns safeguarding the data which is loaded into the unit and its capability to function properly. When a memory device such as a metallic drum, plated wire core, magnetic donut, thin film, or disc file is permanently mounted within the housing of a computer mainframe or peripheral equipment, the fire protection required shall be equivalent to that prescribed for the equipment. Protection requirements for memory devices in this category are set forth in Chapter III, entitled "Machines and Cables". When, however, punched cards, magnetic tape, or magnetic strips which do not remain permanently mounted within the equipment are used, these types of memory devices shall be stored in containers appropriate to protection of the medium concerned, as specified in paragraph 6, 7, and 9 below. Memory devices in this category shall be handled as machines and equipment with required protection being determined by relative importance of the data to accomplishment of the mission and the degree of exposure involved.

502-6. Records Kept Within the Electronic Equipment Area But Not Mounted or Located Within the System.

a. General. The quantity of such records shall be kept to the absolute minimum required for immediate use.

b. Records on Paper-Based Materials.

(1) Vital and important records on paper-based materials shall be stored in Class A, B, or C safes, Class C insulated record containers or Class C insulated filing devices according to the degree of fire exposure involved. These classes conform with NFPA No. 232, "Protection of Records". (Class A is rated at 4-hour protection, Class B at 2-hour and Class C at 1-hour.)

(2) Useful records shall be stored in totally enclosed metal files or cabinets.

(3) Nonessential records (Class 4) shall not be maintained in (a) the electronic equipment area, (b) the record room or library, or (c) security depository. Rather, records assigned to Class 4 shall be accumulated in a disposal staging area, or the equivalent, pending authorized disposal.

c. Records on Plastic Materials. All records on plastic materials shall be stored in moisture-resistant containers within Class A, B, or C safes or other insulated filing devices according to the degree of fire exposure involved. Class 1 (Vital Records) and Class 2 (Important Records) shall be stored in A, B, or C safes, as appropriate. To provide records on plastic materials with adequate protection, safes or filing devices selected for use shall be constructed with inner repositories of special liners designed to eliminate or reduce the internal release of heat and/or steam. Any Class A, B, or C safe, Class C insulated container or filing device, that is also identified as Class 150 by Underwriters' Laboratories, Inc., shall be considered as having sufficient protection to prevent internal release of heat and/or steam for the period of the hourly rating indicated on the device.

Note: The vast majority of plastic tapes are kept on reels constructed of readily combustible polystyrene or other plastic materials. Tape reels are usually inserted in individual cases made also of readily combustible polystyrene, although some reels are stored by means of a wrap-around band covering the slot in the reel. This type of band, which eliminates use of an individual reel case, is commonly made of polyethylene. Tape reel packs, consisting of plastic tape, plastic reel, plastic reel case or wrap-around band, present a serious fire development potential, particularly where large quantities of tape are stored. Seriousness of the fire potential arises because burning characteristics of the plastic involved are extremely hazardous, being much more severe than the equivalent characteristics of paper.

d. Records on Metal Materials.

(1) Vital and important records shall be stored in Class A, B, or C safes, or Class C insulated filing devices according to the degree of fire exposure involved.

(2) Useful records on a metal base do not require special protection unless the reel or container is of plastic or paper type material. In such case, the protection shall be as indicated in b or c above.

502-7. Records Stored Outside of the Electronic Equipment Area.

a. General. To the maximum extent consistent with efficient operations, all records shall be stored outside the electronic equipment area. An adjacent, properly protected records or tape library opening directly into the computer area and meeting the requirements of subparagraph b, c, and d below constitutes an acceptable area.

b. Records on Paper-Based Materials.

(1) Vital and important records shall be stored in Class A, B, or C safes, Class C insulated record containers, Class C insulated filing devices or in fire-resistive rooms or vaults. Records should be stored in locations subject to no more than light hazard fire exposure and the protection equipment and records storage room (or vault) shall have a fire resistance of at least one hour. In instances where records must be stored in locations subject to a higher degree of exposure, fire resistive qualities of the protection equipment used shall be increased to a level commensurate with the hazard involved, but not less than 2-hour fire resistance for ordinary hazard exposure or 4-hour for extra or high hazard exposure. Records storage rooms and vaults shall also be provided with automatic sprinklers or other installed fire extinguishing systems as prescribed elsewhere in this handbook.

(2) Useful records do not require special fire protection over that normally required for paper storage, unless stored in close proximity to vital or important records. In such cases, protection requirements for the most valuable category will similarly apply to other categories stored in the immediate area.

c. Records on Plastic Materials. Vital, important, and useful records shall be stored in a separate fire-resistive room or vault equipped with automatic sprinkler protection. In locations of light or ordinary fire exposure to the vault, the vault shall have a fire-resistance rating of at least 2 hours. In areas of higher fire exposure the vault shall have a fire-resistance rating of 4 hours or more depending on the degree of fire exposure involved.

d. Records on Metal Materials. Records on metal materials require the same protection as paper records except that installed fire extinguishing systems are not required for vaults used exclusively for the storage of such materials.

Note: See Appendix B for descriptions of the fire hazards of occupancies.

502-8. Record Containers. When records are kept in combustible cases, boxes, or other containers, protection shall be the same as required for the most hazardous or damageable media in the total assembly. The type of container will be determined in accordance with the class of records involved.

502-9. Duplication of Records. The surest method of safeguarding records consists of duplicating and storing copies in an area separate from the originals. This normally assures that the two sets of records will not be subjected to damage from the same fire. In some electronic installations, duplication of records on the same or different media is a common practice. Government-wide standards describing the resistance of different magnetic tapes to fire exposures have not been officially established. It is known, however, that fire exposure which would not damage paper-based materials may seriously deteriorate magnetic and other plastic-based recording media.

a. All Class 1 (vital) records on paper, plastic, metal or other bases shall be duplicated; as a standard operating procedure; duplicates shall be stored in a separate fire area from that housing the originals, preferably in a separate building.

b. Whenever practical, Class 2 (important) records shall be similarly duplicated and stored.

502-10. Records in Locations Subject to Building Collapse. Records prerequisite to the operation of an electronic equipment installation shall be housed in buildings having sufficient resistance to prevent collapse under the maximum expected fire exposure. Instructions in Chapter II, applicable to location and construction of buildings housing electronic equipment, shall also be adhered to in selecting buildings to be used for storage of all vital, important and useful records required for electronic equipment installations.

CHAPTER VI - MOBILE EQUIPMENT

601. GENERAL.

601-1. The term mobile units as used in this chapter shall mean parked or positioned trailers and similar equipment used as substitutes for traditional building structures to house essential electronic equipment. Electronic equipment operated in vehicles in motion is not included.

601-2. To the extent applicable, the requirement in the other parts of this document shall be applied to mobile electronic equipment. In particular the requirements covering the use of only noncombustible materials for construction, insulation, and interior finish of electronic equipment areas, the special protection requirements of electronic equipment and the protection of records shall be followed in intent when conformance in fact is not possible. Listed below are specific requirements unique to mobile equipment.

602. TRACTION SOURCES.

Where internal combustion engine powered tractors or similar means are used as the motive power for the movement of mobile equipment, such equipment shall be disconnected (including the fuel supply) and removed a sufficient distance from the electronic equipment so as not to present a fire exposure to the electronic equipment.

603. SPACING.

Mobile units should be separated insofar as feasible.

604. TRAILER CONSTRUCTION.

Trailer bodies or the body of other types of mobile equipment housing electronic equipment shall be of noncombustible construction. Magnesium or other materials which can contribute to a fire shall not be used.

605. TEMPORARY CONSTRUCTION.

Connecting corridors and other temporary construction used in connection with, or in close proximity to, the electronic equipment shall be of noncombustible materials.

606. GENERATOR HOUSES.

Generator houses or other facilities using flammable liquids shall be located a sufficient distance from the electronic equipment so as not to present a fire exposure to the electronic equipment. This distance shall be at least 50 feet unless the natural terrain or other noncombustible barricades provide a fire barrier between the fuel and the electronic equipment.

701. GENERAL.

Emergency operations include the establishment of programs for firefighting and other self-protection organizations, salvage procedures, arrangements for continuance of operations after fires and programs for the replacement of destroyed records.

702. FIRE EMERGENCY ORGANIZATION.

702-1. An emergency fire control organization for each electronic equipment operation shall be established. The following paragraphs describe functions which should be included in such organizations but do not attempt to dictate the exact organization. Each facility must determine its individual best method of providing the needed protection.

702-2. The purpose of the fire emergency plan shall be to:

- a. Prevent or minimize danger to life and to prevent injury.
- b. Prevent or minimize damage to electronic equipment.
- c. Prevent or minimize danger to vital and important records.
- d. Preserve the ability of the electronic equipment to perform its missions.
- e. Prevent or minimize damage to other operations and equipment.
- f. Prevent or minimize damage to the building housing the operation and other buildings in the area.

702-3. Emergency teams should be organized and trained to use the available first-aid firefighting equipment to combat incipient fires. All personnel in the area should also be trained in the use of fire extinguishers and other available first-aid firefighting equipment for independent action and to reinforce the emergency teams.

702-4. Duties of the emergency teams should include:

- a. Ascertaining that the fire alarm has been turned in and the fire department has been called.
- b. Assuring the evacuation of personnel from any area of fire danger.
- c. Directing emergency shutdown of electronic equipment and utilities. Normally, building lighting should not be shut down.
- d. Conducting firefighting operations until relieved by the arrival of the fire department or other higher authority.
- e. Directing the fire department to the scene of the fire and standing by to aid the fire department and provide information.
- f. Directing the removal of portable equipment and records endangered by the fire.
- g. Informing management of the incident and extent of loss and damage.

702-5. As can easily be seen the duties of the emergency teams require considerable pre-planning and training. In addition to being trained in the effective use of the various types of emergency equipment, it is essential that practice drills be held frequently and the entire operation, to be followed in case of fire, studied and practiced. Each member of the emergency teams should know which equipment and records are the most important and should therefore receive the first attention in case of fire.

702-6. While the training of the emergency teams should be the most complete, all personnel involved in the operation of electronic equipment should have a good understanding of what to do in case of fire, be ready to support the emergency teams and be able to act on their own initiative if necessary. It is of prime importance that every person working in an electronic equipment area know how and when to use emergency shutdown controls, any fixed fire protection systems, and portable fire extinguishers.

703. SALVAGE OPERATIONS.

703-1. In the event of fire, particularly fires which advance to the point where there is either the spread of smoke or the use of water, prompt salvage operations can aid greatly in rapid restoration of operations and limitation of damage. Immediate action is one of the main keys to successful salvage operations with preplanning before the fire as an equally important item.

703-2. When the electronic equipment is located where water may be used on the floor above to fight fire, or there are other possibilities of water from an outside source falling on the electronic equipment, means should be provided to prevent the water from entering the electronic equipment. The proper method of doing this will vary according to individual design of each piece of equipment. In some instances adequate shielding can be obtained by simply taking off the side covers of the equipment and placing them on top of the exposed units. In other cases prepared covers or waterproof tarpaulins will be needed.

703-3. Whenever electronic equipment has been contaminated with water, firefighting chemicals, smoke or soot it is vital that action be taken to clean and dry the electronic equipment as soon as possible. If clean water is the contaminant, drying is all that is necessary. However, if the equipment is contaminated with smoke, soot, or fire fighting chemicals, cleaning before drying is called for. Failure to remove contamination promptly may greatly increase the damage.

703-4. A supply of "Water-Displacing Compound," Federal Specification O-W-001284, Amendment 1 of December 4, 1967, Type I and Type II should be available so that emergency treatment of damaged equipment can begin as soon as the fire is out.

NOTE:

CAUTION: The water displacing compounds, both Types I and II may be flammable at room temperature. If so, all sources of ignition, such as pilot lights, etc.; should be turned off and appropriate safeguards taken. In addition, avoid inhaling the vapors of the compound as they may be injurious to health. Both of these precautions should be prominently displayed on the container, but in the event they are not, be guided by the above cautions.

a. When equipment is contaminated with dirty water, firefighting chemicals, or smoke and it cannot be cleaned within 24 hours after contamination, corrosion and deterioration may be reduced by means of an emergency treatment. This consists of washing as much soot, smoke and/or firefighting chemicals as possible from the equipment with a medium pressure water spray. The wet equipment should then be sprayed with Type I "Water-Displacing Compound" and allowed to dry. At the earliest possible date this equipment should be salvaged by cleaning in accordance with instructions given in the Naval Ships Technical Manual, NAVSHIPS 250-000, Chapter 9190, Section X, "Reconditioning of Flooded Equipment."

b. Clean wet equipment can be dried by spraying the wet equipment with Type II "Water-Displacing Compound", and then blowing the equipment with warm air to evaporate the mixture of water-displacing compound and water. Good ventilation is necessary for the above operation.

703-5. The location of salvage covers, mops, brooms, and other equipment useful in the reduction of damage should be ascertained and made readily available to the emergency teams and others who may be called on to remove water and otherwise aid in salvage operations.

703-6. With respect to records damaged by fire and water, the Federal Fire Council's Recommended Practice No. 2, "Salvaging and Restoring Records Damaged by Fire and Water" outlines certain simple first aid actions which will increase the salvage potential of damaged records. Speed of application is often essential to successful salvage. Copies of this publication may be obtained from the Federal Fire Council or from the nearest Federal Records Center of the National Archives and Records Service.

704. REESTABLISHMENT OF OPERATIONS.

704-1. The prompt reestablishment of operations after a damaging fire depends on the availability of alternate equipment which can be used to perform the functions of destroyed equipment, the ability to replace the damaged equipment or records and the restoration of any damaged facility or the ability to use an alternate area for substitute equipment.

704-2. The existence of similar electronic equipment or equipment capable of performing the mission of the electronic equipment under consideration does not constitute an available alternate source. The alternate equipment must be in a location which can be used, and must have available machine and equipment time to take over the functions of the disabled operation without causing the stoppage of other, possibly more important, operations. To the maximum extent possible, all alternate operating facilities should be determined and prior arrangements established for mutual aid in continuing functions in case of fire.

704-3. Accurate records of the types of equipment used and particularly any modifications or changes made after installation should be kept in a location separate from the electronic equipment, to aid the manufacturer in prompt replacement of any destroyed equipment.

704-4. Plans should be made for the transfer of personnel, supplies, and equipment to alternate sites and for the expedient handling of replacement equipment.

704-5. Management personnel of electronic equipment operations should familiarize themselves with available structures and other locations where emergency operations can be conducted if the existing facility is destroyed or made temporarily unusable. This should include an appraisal of the alterations to the structures being considered and the adjustments to the operation that would be required.

704-6. Plans should be developed for regathering and reproducing records destroyed by fire.

704-7. Because of the importance of the above-mentioned planning, all of the possibilities should be formalized in written emergency operation plans.



APPENDIX A

SIGNIFICANT FIRES AND EXPERIENCES INVOLVING
ELECTRONIC EQUIPMENT

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APPENDIX A

SIGNIFICANT FIRES INVOLVING ELECTRONIC EQUIPMENT

The following is a list of significant fires involving electronic equipment which have come to the attention of the Federal Fire Council. It is emphasized that this may be only a partial list.

Where possible from the records available to the Council, the type, make, class or other identifying characteristics of the electronic equipment have been included to give the reader a clearer picture of the situation. The reader is cautioned not to judge the quality of the equipment based on these descriptions of fires because of their brevity and because the manufacturers of the equipment in many cases have used the knowledge learned from these fires to make improvements aimed at preventing a recurrence.

NOTE: In categories I, II, and III, which have been divided into two sections (i.e. A - Electronic Computer Systems, and B - Other Electronic Equipment) every care has been taken to properly classify the losses, however, in some instances computer or logic elements may have been involved but available information is not sufficiently clear for positive classification.

New Section IV "Wire and Cable Fires" has been added in this revision because of the similarity of all cable fires.

New Section V "Miscellaneous Incidents involving computers" contains interesting incidents involving computer facilities.

I. Fires Originating, Or Suspected To Have Originated, Within Electronic Equipment.

A. Electronic Computer Systems:

1. December 10, 1957 (\$127,000) -- Arcing ignited plastic harness in IBM 650 Unit. Machine destroyed, damaged to nearby 655 Power Unit. Use of plastic harness since discontinued in this type equipment.

2. February 28, 1958 (\$100,000) -- Identical to fire of December 10, 1957. (IBM 650 Unit), except that the fire did not spread to other units in the system.

3. March 19, 1961 (\$30,000) -- Fire started from spontaneous ignition of carbonized wood in a power-pack enclosure of a TRW digital and analog computer, the equipment having been continuously energized over a considerable period of time. Fire was discovered and extinguished by a watchmen with CO₂ extinguishers and a small hose line with spray nozzle before sprinklers opened. Fire was confined to the power-pack unit where practically all of the damage occurred. The AEC supported research project for which this computer was used was delayed for an extended period (business interruption value never calculated).

4. March 26, 1961 (\$15,000) -- A short circuit in a circuit breaker of an IBM card punch ignited interior insulation. A passing security patrol smelled smoke and extinguished the fire with CO₂ extinguishers through the enclosure openings. Fire was confined to the card punch machine (part of a Philco 2000 EDP System).

5. August 16, 1967 (Estimated \$150,000) -- Computer unattended at night. Located in a separate structure within a large building. Alarm transmitted by automatic sprinkler discharge. Firefighters had to force entry and found smoky fire. Using air-packs they checked the backs of the computers and found all cool. One sprinkler had activated and put out the fire. The fact that the back was off the console because jumper cables were in use assisted in the control of the fire. Power supply is shut off nights but 24 volt heaters, built into the circuit boards, were left on to keep the various cards warm. Cause was short circuit on one board made of epoxy-impregnated glass fiber which ignited and involved other cards. Air conditioning system continued in operation thereby carrying away a portion of the smoke generated.

6. October 26, 1967 (\$150,000) -- Plastic cased cooling fan, 208 volt, apparently ignited printed circuit boards which then involved polyvinyl chloride insulation on wire in bundles. On duty personnel attempted extinguishment with two 15# CO₂ extinguishers but were driven out by dense toxic smoke. Building was incombustible and sprinklered. Alarm was prompt with response within five minutes. One sprinkler head controlled the fire. Water was removed from the computer room, the room sealed off and air conditioning used to dry out the rest of the equipment. This took 36 hours. Comments were: "That smoke or similar solid particle combustion products rather than water or heat may cause excessive damage to equipment" Magnetic information storage may be extensively damaged. Valued at \$125,000.) There have been two or three similar occurrences.

I A 7. April 18, 1963 (Amount of damage not reported) -- at 1:20 a.m., the computer operator smelled smoke and discovered fire in computer-type equipment. Smoke was issuing from the equipment and when the rear door of the cabinet was opened flames shot out. Appropriate circuit breakers were immediately manually activated and the fire extinguished by the use of a CO₂ extinguisher. The fire detection system activated only after the fire was extinguished. This delay was caused by drafts in the air.

The fact that the origin of this fire was not destroyed as a result of the fire, allowed investigation of the type and nature of the ignition source. The fire started when a resistor mounted on epoxy-base fiber glass printed-circuit card, overheated because of excessive current. The circuit board on which the resistor was mounted became ignited at the top corner and fire passed upward involving the two circuit cards above. This fire brought attention to the fact that with this class of equipment serious fires are possible.

Had this fire not been promptly extinguished there seems to be little doubt that the entire contents of the cabinet would have been involved in a short period of time.

B. Other Electronic Equipment:

1. September 5, 1957 (\$134,744) -- Radar control van. Overheated filament transformer in power pack started fire. Spread was to selenium rectifier and to magnesium shell of van. Fire in magnesium shell was a major factor in loss.

2. Fiscal Year 1967 (Loss not stated) -- Electronic equipment in a sprinklered area but shielded by magnesium housing. Fire occurred within the housing and sprinklers could not get water to the seat of the fire. However the sprinklers did operate. They were shut off several times in an effort to decrease the so-called water damage. This resulted in high levels of heat in the enclosures which resulted in destruction of all transistors in the equipment. Water can be an effective coolant.

3. March 12, 1959 (\$7,698) -- Radio repair office in nonsprinklered combustible building. Fire originated in rectifier and involved combustible building materials.

4. September 9, 1959 (\$493,678) -- Electronic sound equipment. Probable cause was defective system wiring in confined space above ceiling. Means of fire spread uncertain, probably combustible interior finish.

5. August 26, 1961 (\$275,000) -- Air navigational aid. Fire of unknown origin in unattended, locked building. Equipment was operating and electrical breakdown or fault is suspected. Entire building (1,296 square feet) was destroyed.

6. October 11, 1961 (\$100,000) -- Air navigational equipment. Fire originated in power equipment. Fire could not be controlled with available carbon dioxide fire extinguishers and spread through building (equipment shack of 500 square feet).

7. November 10, 1967 (\$10,000) -- At 3:45 p.m. flames were discovered in a transmitter cabinet. Oil was dripping onto cables which were afire. CO₂ extinguishers were used but had little effect. Five minutes after discovery the fire alarms were manually actuated - automatic alarm had failed. Personnel had a hard time using the CO₂ extinguishers because of acrid smoke. Breathing apparatus was used. After the CO₂ was exhausted, dry chemical was applied and extinguished the fire. Virtually all components in the rear of the transmitter were heat damaged. Horizontal shelves were warped considerably. Cables were stripped of insulation. Investigation found that the cooling air blower was wired to rotate in the wrong direction.

8. A magnetic tape eraser unit overheated and caught fire in a customer engineer's shop. One sprinkler head operated and extinguished the fire. Loss \$2,000.

II. Fires Originating Outside Of Electronic Equipment But Directly Related To The Equipment Or Its Special Environment.

A. Electronic Computer Systems:

1. February 20, 1959 (Amount of loss not reported) -- Carelessly discarded cigarette ignited carbon paper at a decollator machine. Water type extinguisher used to put the fire out.

2. March 11, 1959 (\$147) -- Coat thrown on a hot soldering iron ignited after all persons had left the area. One automatic sprinkler head operated and extinguished the fire.

II A 3. June 13, 1959 (\$254,030 plus 6 IBM machines of unspecified type and value) -- Lightning struck window air conditioner, jumped to water line, ignited exposed paper and punch cards. Spread was across other combustibles in the area. Some original records were destroyed.

4. July 2, 1959 (\$6,500,000) -- Three complete computing systems destroyed along with over 5,000 reels of magnetic tapes. Fire originated from contact of a 100-watt light bulb with the fiberboard ceiling. Fire spread to plastic tape cases and across the fiberboard acoustic ceiling. The entire computing center was burned out.

5. September 29, 1963 (No loss) -- Paper on a 1403 printer caused a short in a cable controlling motors was source of fire. Operator used 5# CO₂ to extinguish.

6. November 12, 1963 (No loss) -- Spark ignited paper dust on card sorter machine. Operator used 5# CO₂ to extinguish it.

7. September 27, 1966 (Not reported as a loss) -- Alarm sounded by products of combustion detector under the raised floor. The plenum under the floor was filled with smoke but not fire. Fire traced to 7-1/2 H.P. motor on a fan for the computer air conditioning system. No fire. Computer down approximately 2 hours.

8. June 11, 1968 (Damage not stated) -- A fire developed in an IBM 714 printer and apparently started as an overload in a 40 volt dc. 25 ampere generator. The fire was quickly extinguished by personnel in the immediate area. Although the room rapidly filled with smoke, the automatic ionization type detector did not operate. Many of the detectors were located above the false ceiling and were subject to a high rate of air flow. The smoke was diluted to a point below the detectors sensitivity setting. Checks made with the manufacturer's equipment proved that the sensitivity was far below the factory recommendation for use in computer rooms. Apparently a service technician, while initially checking the system, did not adjust the detectors to a realistic setting in keeping with the environment of the area. Correction was made by remounting three quarters of the detectors below the false ceiling and by increasing the sensitivity to the factory recommended settings.

B. Other Electronic Equipment.

1. August 7, 1952 (\$252,082) -- Defective electric circuit breaker ignited a two-story, large, electronics laboratory building.

2. December 26, 1967 - (\$1,910,204) -- A fire was discovered at 1255 hours in a complex of 15 vans housing electronic gear, all interconnected with wooden walk ways. Interior walls were light combustible plywood; exterior sheeting was magnesium and aluminum. Most probable cause was electrical malfunctioning of a heater unit in one of the vans. Twelve vans were totally destroyed and three were severely damaged. There were no fire vehicles or fire protection personnel assigned to the site. Fire fighting services from nearby communities responded. Because of the distance; however, the first vehicle arrived 25 minutes after they received the alarm by which time the fire had completely involved the complex.

III. Fires Originating from Causes Not Directly Involving Electronic Equipment.

A. Electronic Computer Systems.

1. September 2, 1959 (\$76,100) -- Defective fluorescent fixture ignited fiberboard acoustic ceiling in wood frame quality evaluation laboratory. Major portion of loss was in electronic data processing equipment.

2. October 3, 1960 (\$1,700,000) -- IBM 650 System was destroyed when a building burned down. Fire apparently resulted from a defective ballast on a fluorescent fixture which ignited the fiberboard acoustic tile. It then spread to the vapor seal on the attic insulation and rapidly enveloped the entire building.

3. September 10, 1965 (\$3,640,000) -- An incendiary fire was started in one section of the one-story, noncombustible office building, and was mostly confined to this 150 x 300 foot section. Fire was reported to be set by a disgruntled former employee in the personnel section next to the compartment in which a valuable computer (reported to be an IBM 7090) was located. Fire spread under the roof and through corrugated metal and fiberboard partitions, destroying the computer area. This section of the plant had no built-in protection.

III A 4. February 13, 1966 (Damage estimated at \$2 million) -- Fire broke out in the restaurant kitchen on the top of an airport terminal complex. The fire then rapidly spread by means of a ventilation system throughout the building including the airport control tower, and the weather bureau headquarters. The fire occurred at 3:30 p.m. and there was suspected arson. This important terminal was shut down by the fire damage for approximately 48 hours, with all flights normally scheduled into the airport having to be diverted. Quick restoration of the facilities was obtained by the use of portable military equipment because there was much use of the port by military flights. The commercial airlines also using the airport would be diverted for sometime in the distant future before they would be allowed to come into the airport.

5. August 23, 1966 (\$350,000) -- Escaping flammable gas in basement area exploded with tremendous violence, destroying a Honeywell H-200 computer system on the floor above. A UL-listed "four-hour" firesafe cabinet, containing 150 key tapes, withstood the blast and the following fire, making it possible for most ADP work to be resumed on an H-22 computer several hundred miles distant, the following morning. A replacement computer was operative at the plant within six days. The overall plant suffered a multimillion-dollar loss and some fatalities.

6. 1966 (\$2.5 million) -- Incendiary fire in combustible waste involved a computer housed in a small corrugated metal compartment in a corner of a large building. Most of the structure and contents, including the computer, were destroyed.

7. A fire was started in the combustible fiberboard ceiling of a computer room by a fluorescent light ballast. It was put out with hand extinguishers before the sprinkler system was actuated. Damage negligible.

8. Fire in early 1968, possibly May (Amount of damage not stated) -- Fire started below the computer room and within 3/4 of an hour from the start of the fire the floor had collapsed allowing the IBM machine to drop one floor to its total destruction. The report states that within 24 hours new equipment was on the road and a new building was found and wired up. An associate firm took part of the load and handled 25% of the program. The various agencies were able to find labor squads which were ready and obtained the trained personnel necessary to repunch cards. Most of the cards were readable by eye but not usable through a machine. Certain precautions for duplication of material had been made and were very valuable.

B. Other Electronic Equipment:

1. February 3, 1958 (\$270,000) -- A frame, electronic shop building was burned down in a fire resulting from an overheated electric fan.

2. May 17, 1958 (\$280,998) -- Spontaneous heating of oil-soaked rags in adjacent operation ignited combustibles and spread through fiberboard partition to electronic training equipment.

3. February 6, 1959 (\$136,376) -- A defective ballast on a fluorescent light ignited the fiberboard acoustic ceiling in a two story, wood frame, unsprinklered building being converted to an electronics school. Fire spread quickly across the ceiling.

4. December 1, 1962, New York City, Bank (\$29,000) -- Fire caused by welder in insulation of air conditioning ducts in the third sub-basement extended to the paper-storage room in the second basement, where fire was confined by the operation of a single sprinkler head. Smoke caused damage to Honeywell controls and to tapes and memory drum in the adjacent computer room on the same floor. There was no fire in the room.

5. March 1967 (Government loss \$35,000 to equipment plus clean up costs of \$25,000; loss to others \$150,000) -- Fire broke out in assembly shop adjacent to computer area. Building unoccupied -- fire noticed by policeman who notified the fire department. Smoke was so thick that fire fighters had difficulty locating the fire. This took approximately one hour. The fire was extinguished with two 1-1/2" hoses with fog nozzles. Two inches of water had to be pumped out from under the raised floor. Heat melted solder on some printed circuit cards in the memory transfer unit. The unit was ten feet from the fire. The fire started at plywood work tables. Possibly electrical equipment may have overheated. Lack of detection or sprinkler equipment delayed discovery while room was unattended. Computer rooms should be cut-off from other ordinary operations. This points up futility of exposing valuable equipment to low value areas containing fire hazards.

6. Other significant miscellaneous fires and other losses associated with computer facilities reported included:

III B 6. a. Fire hose streams being used on a construction shack fire water-damaged a large quantity of deck cards stored in a completed section of a new building. Loss was \$60,000.

b. Tabulating cards and associated computer records were destroyed in an unsprinklered basement fire. Smoke damage also occurred on floors above. Computer equipment was not involved. Loss was \$35,000.

c. Fire started by defective water cooler thermostat in computer room destroyed paper cartons, deck cards, and other supplies. Operator extinguished fire; computer was not involved. Loss was \$2,300.

d. Data processing equipment in an accounting office in an unsprinklered building was damaged by heat and smoke. Only deck cards were wet. Loss was \$67,000.

e. A frozen wet-pipe sprinkler system above a computer room ceiling dripped water on ceiling, carpets, office supplies and deck cards. Computer was not involved. Loss was \$5,000.

f. A fire in a stereotype melting-pot duct opened a sprinkler head on the fifth floor. Fire was controlled but records and deck cards on the fourth and fifth floors were damaged. Loss was \$6,000.

g. A fire started by a soldering iron on a bench in a computer room was put out by one sprinkler. Damage was \$150.

IV. Wire and Cable Fires.

Because of similarity of cable fires occurring in electronic equipment operation and those occurring in ordinary electrical operations both types of cable fires have been included. Section IV has been subdivided into four sections as follows:

- A. Fires Originating In Computer Or Other Electronic System Cables But Not Including Telephone System Cables.
- B. Fires Involving Telephone Systems Cables.
- C. Fires Involving Cables Not Identified As Computer, Other Electronic Equipment Or Telephone Equipment Cables.
- D. Fires Originating In Places Other Than The Cable But Propagating To Or On Cable Installations.

IV. A. Fires Originating In Computer Or Other Electronic System Cables But Not Including Telephone System Cables.

1. January 5, 1965 (\$25 million) Space Tracking Station -- Windowless, incombustible building involved high density of open control and power cables of relatively small diameter plus electronic computers, programmers, controls and special electronic devices. A destructive arc occurred which the operators fought with CO₂ extinguishers. The fire continued to spread in the insulation of the cables and ten minutes after discovery of the fire all personnel were ordered out of the building because of the dense smoke and toxic fumes. Up to this time, no water had been used. In reconstruction of the building and equipment, sprinklers were installed "where needed." Use of the facility was lost for many months.

2. Fall 1965, Melbourne, Australia, (Loss, Unknown) -- A CDC 3200 computer was "drenched" when an automatic-sprinkler system was activated by a fire in the room. The brief report states the computer suffered negligible damage, and it was operable within eight hours.

B. Fires Involving Telephone Systems Cables.

1. May 22, 1953 (\$215,000) - Telephone exchange -- A short circuit caused fire at the switchboard and fed on combustible covering of grouped telephone cables. Public Fire Chief held up using large hose streams for as long as possible, but finally found their use necessary. Much of the damage was from water. Restoration of full service required 4-1/2 months.

2. November 7, 1958 (\$145,000) Telephone exchange -- Insulation in the selector wiring ignited, possibly from a sparking switch. A telephone signal automatically notified a serviceman who went to the unattended building. Fire was noted and the public department quickly responded and extinguished the fire with water spray.

IV B 3. November 12, 1960 (\$207,000) - Telephone exchange -- Defective wiring is thought to have caused a fire in telephone dial equipment. Building was combustible. Fire had to be fought from outside due to heavy smoke.

4. February 4, 1965 (\$1 million) -- Possible short circuit in low voltage power telephone cables ignited insulation on adjacent cables. Combustible sheathing on ceiling increased the fire. Insulation on wires was polyvinyl chloride or neoprene both classified as "flame resistant". Fuse did not blow when short occurred. Fire burned 3-1/2 hours because of smoke. Fire department finally broke holes in concrete roof to ventilate.

C. Fires Involving Cables Not Identified As Computer, Other Electronic Equipment Or Telephone Equipment Cables.

1. June 1, 1960 (\$100,000) -- Wood fiber products-control panel fault caused ignition of the combustible covering of cables in a tray. Fire was extinguished within 20 minutes by the use of several large hose streams. Intense heat caused the asphalt on the roof to melt and roof sagged. Repairs took six weeks.

2. August 24, 1960 (No amount stated) Steel Rolling Mill -- An electrical breakdown occurred in one or more of 200 cables contained in a 24-inch, open mesh steel tray, suspended about 30 inches below the concrete ceiling. Plant and city fire departments spent considerable time applying CO₂, foam, dry powder, and water to extinguish the fire. Business interruption costs amounted to about \$350,000.

3. November 5, 1960 (\$1,425,000) - Metals Salvage Plant -- Electric cables were in metal cable trough attached to the combustible outside wall sheathing. Deterioration over the years in the paper and canvas insulation finally allowed an arc, igniting insulation in several troughs. Lack of automatic sprinklers allowed the fire to continue undiscovered for an hour or more and destruction was excessive.

4. March 12, 1961 (\$20,000) Fertilizer Mixing -- Electric arc in control room ignited insulation on grouped power and control conductors. Fire department used hose streams in extinguishment.

5. March 8, 1962 (\$500) - Power Plant -- Smoke and flames noticed coming from power supply unit. Operators extinguished the flame with a 4# CO₂ extinguisher. Fire source was a transformer failure which spread to cable.

6. August 29, 1963 (\$750,000) - Aluminum Milling Plant -- A small electrical arc in a 440 volt cable triggered the fire. Fuel for the fire consisted primarily of combustible insulation on exposed cables in trays. In the absence of control power, protective relays would not operate to interrupt arcing. Electrical center room contained far too much equipment. All processes were shut down for several days, and two weeks after the fire the plant was operating at only 50% of full production. Business interruption loss was \$1,500,000.

7. September 24, 1965 (\$1,308,000) -- High-amperage power cable malfunctioned in a combustible concealed space in a two-story, wood frame, unprotected communication building. Low-density fiberboard, a delayed alarm, and involved security restrictions contributed to the rapid spread. Eleven military personnel died primarily from smoke inhalation. The fire damaged about \$465,000 in computer equipment and \$590,000 in other electronic equipment, in addition to other property losses. Automatic sprinkler protection had been recommended by a fire protection engineer, but was not installed for fear of water damage.

8. December 8, 1966 (\$3,000) Bank -- Electric short circuit in service to computers (main panel box) ignited fires in wires.

D. Fires Originating In Places Other Than The Cable But Propagating To Or On Cable Installations.

1. January 6, 1959 (\$17,000) Steel Rolling Mill -- Fire, probably from a discarded cigarette into debris, burned practically all of the insulation from 30,000 feet of cables, and 10,000 feet of instrument wiring. It was very difficult to get at the fire with hose streams. The two weeks shut down in production cost \$80,000.

2. May 1, 1963 (\$500,000) Telephone Exchange -- An employee, working on switching equipment frame ignited a canvas bag accidentally with a soldering iron. Ineffective use of CO₂ extinguishers failed to put out the fire. Public fire department used small hose streams to extinguish the insulation fire.

IV D 3. February 3, 1965 (Loss not stated) - Atomic Power Station -- Fire destroyed about 1100 control and power cables. They were of the multiconductor type with jackets of polyvinyl chloride insulation, while the insulation of the power cables was butyl rubber. Some of the control and instrumentation cables were covered with polyethylene. Cause of fire probably hot metal falling from acetylene metal cutting operations. After futile efforts with CO₂ hand extinguishers, a tank-truck of CO₂ arrived and about four tons of the gas was introduced into the building. An inert gas generator was also put into operation to reduce the oxygen content. Fuel consisted almost entirely of cable insulation. Operations were delayed about four months.

V. Miscellaneous Incidents Involving Computers

The following are some other interesting fires and other property losses, mostly minor. These reveal some of the typical and ordinary losses computer/ADP systems can be involved in, that require safeguarding.

1. There were five cases in which computers were wet by direct contact with water:

a. A cloudburst caused water to back up through a storm sewer into a basement-located computer. After prompt drying with dehumidifiers and warm air blowers, the computer operated satisfactorily. No damages were claimed.

b. A steam leak from a coil in the room air conditioning system fused one sprinkler head directly over a computer component. Water from the sprinkler head and condensing steam wet internal components. Drying and small repairs took a week. Investigation revealed that the coil had frozen and cracked due to continual operation of the refrigeration during a weekend shutdown; on Monday when the boilers were restarted, steam poured from the line. Loss was \$4,000.

c. Wind ripped a portion of the roof from a computer room during a heavy rainstorm. Labor and associated costs to dry and return equipment to full operation - \$249. Overall building loss was approximately \$50,000.

d. A sprinkler head fused, wetting a solid state computer. The 160°F rated head had been installed too near a hot-air heating outlet. After quick drying, the equipment tested and operated satisfactorily. No damage.

e. A sprinkler pipe above a dropped ceiling cracked and discharged water on a computer system. A small leak developed when the pipe, located in an unheated concealed space, started to thaw after being frozen. Drying restored the equipment to satisfactory operation. The computer system suffered no damage.

2. Several cases of carbon dioxide discharge into computer/ADP equipment have been experienced. Losses ranged from \$100 to \$5,000 and all from electrical or fire causes.

a. One significant case was the discharge of a large six-cylinder bank into a series of computer cabinets after a small fire in the room actuated the automatic smoke detector in the air-exhaust duct. It was necessary to use fans and portable blowers to sublimate the frozen condensate inside the cabinets. There was no permanent damage to the equipment even though the computer had been energized for 15 minutes after the initial discharge. A manual power disconnect had been forgotten in this evacuation.

3. A lightning surge damaged fuses, diodes and an amplifier in one computer and 374 transistors in another. Loss was \$18,000 in property and \$15,000 in business interruption.

4. A 150° -flashpoint organic solvent was heated to over 300°F and then poured (contrary to work rules) into another container. It spilled and flashed into a large ball of flame. One sprinkler head actuated, and controlled the fire until the plant (a major computer mfg.) fire department arrived. Loss was \$49,000.

5. A 3" overhead chilled waterline for numerous drinking fountains in a huge manufacturing building (major computer mfg.) broke. Water and mechanical damage mostly to subminiature components on assembly benches, about \$150,000. Plant is entirely sprinkler-protected.

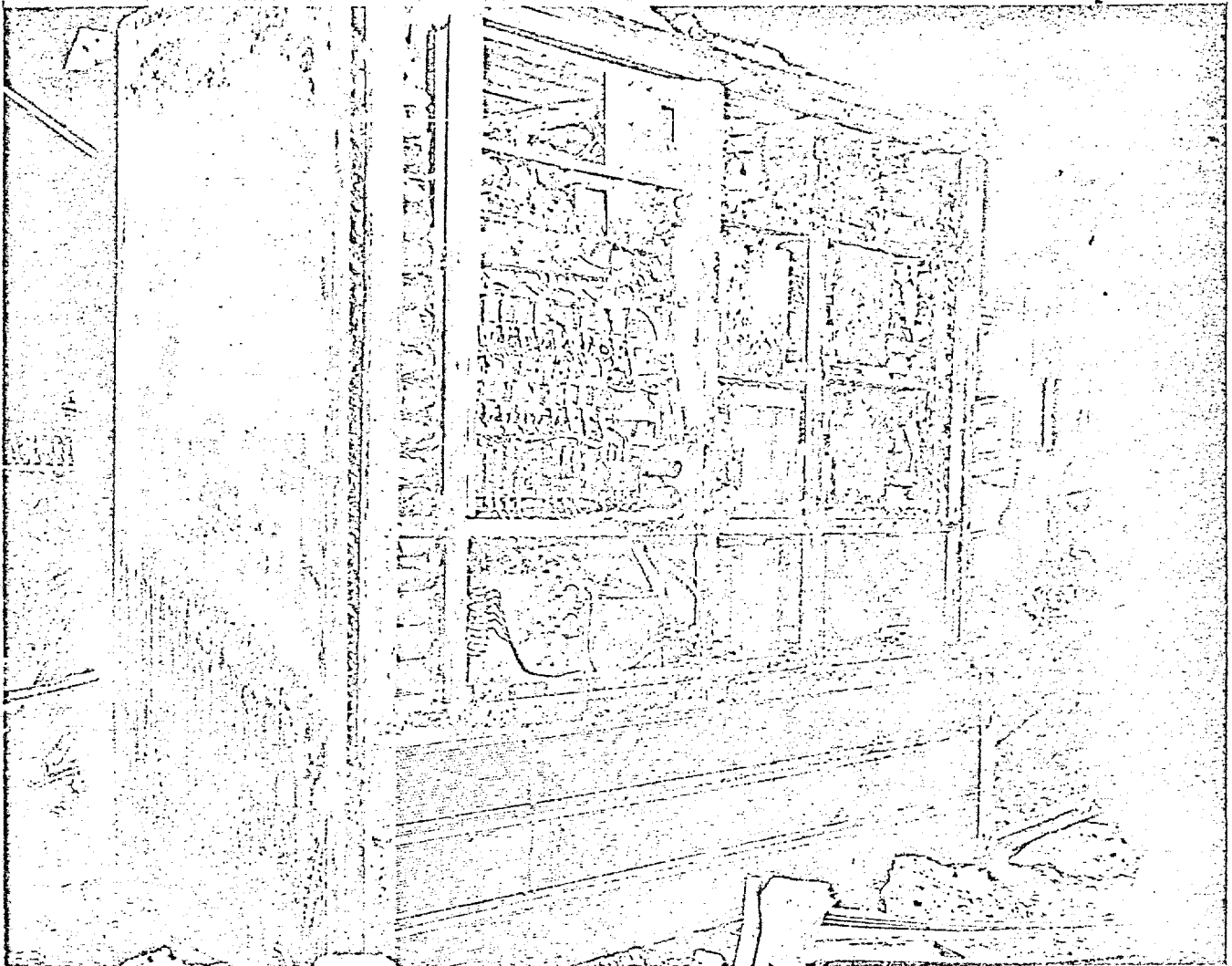
6. A bottle of hydrochloric acid was dropped and broke in a second-story laboratory; the acid penetrated the floor and ceiling below and dripped on a unit of a \$200,000 analog computer. Operator found the hazard; loss was held to \$40.

V. 7. A high wind collapsed a nearby building housing a gas-reducing station. Loss of gas service impaired humidity controls, shutting down the computer system. Length of interruption was not reported. No business interruption insurance was carried.

8. A domestic water pipe froze and burst adjacent to the computer system. Deck cards on the floor were soaked, but water did not reach the computer equipment. Loss was \$800.

9. Spring 1965, Computer Manufacturer's Plant, Loss unknown -- An oven in a computer equipment manufacturer's plant overheated, setting fire to adjacent combustible material. A sprinkler system operated, controlling the fire. Plant operation was not affected. No loss reported (writer's estimate was \$1,000 or less).

10. Spring 1968 -- At 2:10 a.m., a fire alarm was received from a computer facility. Responding personnel noted high humidity and some odor of smoke. A solenoid, which controlled the humidifier water, was found to be burned out causing overheating of the solenoid causing actuation of the fire smoke detection system and the alarm. Quick detection and response prevented loss.



APPENDIX B

FIRE HAZARD CLASSIFICATION OF OCCUPANCIES

A. LIGHT HAZARD OCCUPANCIES - Those with less than ten pounds of ordinary combustibles per square foot of gross floor area and having a fire potential of less than one hour.

Classrooms, conference rooms, auditoriums, dining rooms
Courtrooms, detention cells
File rooms using metal file cabinets
Hospital patient areas
Libraries, excluding large stack areas
Offices using wooden furnishings, less than one person per 200 square feet of floor area.
Rest rooms and locker rooms (with metal lockers)
Offices using metal furniture

B. MODERATE HAZARD OCCUPANCIES - Those with ten pounds to twenty pounds of ordinary combustibles per square foot of gross floor area, and having a fire potential of one to two hours.

Drafting rooms, map making rooms
Electronic, electrical and similar laboratories not using flammable liquids
Mail rooms
Most storerooms
Offices using wooden furnishings where personnel occupancy exceeds one person per 200 square feet
Parking garages
Post office workrooms
Printing and reproduction operations
Shops not involving flammable liquids or production wood-working

C. HIGH HAZARD OCCUPANCIES - Those with more than twenty pounds of ordinary combustibles per square foot of gross floor area or involving significant amounts of flammable liquids, having a fire potential in excess of two hours; or with a potential of fast fire spread which may endanger life and/or the structure.

Automobile servicing, fueling, or repairing
Chemical or other laboratories involving significant amounts of flammable liquids
Flammable liquid operations
General storage warehouses
Library stacks and open shelf file rooms
Major machine shops using large amounts of combustible cutting oils or machining of pyrophoric metals
Paint shops
Production wood-working shops
Trash rooms

NOTE 1: Ordinary combustibles are defined as materials such as paper and wood having an average British Thermal Unit potential heat release of about 8,000 BTU's per pound.

NOTE 2: The above examples are based on typical operations and average distribution of combustibles. Judgment must be used and the level of occupancy hazard increased or decreased where the conditions are not typical and the combustibles involved present either more or less fire potential than the typical situation. For example, mailrooms with low activity or drafting rooms using modern metal furniture are usually light rather than moderate hazards. Conversely, if an office equipped with metal furniture habitually contains very large quantities of paper and similar combustibles, which are not contained within file cabinets or other metal containers, that office would be a moderate rather than a light hazard.

BIBLIOGRAPHY

National Fire Protection Association (NFPA), 60 Batterymarch Street, Boston, Mass. 02110

NFPA No.	Title	Approximate Single Copy Price
10	Portable Fire Extinguishers	\$1.00
12	Carbon Dioxide Extinguisher Systems	1.50
13	Sprinkler Systems	2.00
70	National Electrical Code	2.00
75	Electronic Computer/Data Processing Equipment	0.75
80	Fire Doors and Windows	1.50
80A	Protection Against Exposure Fires	0.35
90A	Air Conditioning and Ventilation Systems	0.75
232	Protection of Records	1.00
252	Methods of Fire Tests Of Door Assemblies	0.50
255	Tests of Surface Burning Characteristics of Building Materials.	0.50

Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Illinois 60611

Standards for Safety:

10B	Fire Tests of Door Assemblies	Free
478-67	Electronic Data-Processing Units	Free

Also U.L. Listings of Equipment and Materials Free

American Society of Testing Materials (ASTM), 1916 Race Street, Philadelphia, Penn. 19103

E-84	Method of Test for Surface Burning Characteristics of Building Materials	Varies
E-136	Determining Noncombustibility of Elementary Materials	
E-152	Method of Fire Test of Door Assemblies	

Federal Fire Council

RP-2	Salvaging and Restoring Records Damaged by Fire and Water.	Free
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Naval Ships Technical Manual, NAVSHIPS 250-000, Chapter 9190, Section X, "Reconditioning of Flooded Equipment." Information may be obtained relative to this salvage process from: Naval Research Laboratory, Washington, D. C. 20390.

NOTE: The individual items may be obtained directly from the organizations indicated. The NFPA and U.L. items are maintained in the Federal Fire Council's fire safety reference library and are available on a loan basis to all Federal personnel. Requests for loans should be addressed to: Central Office Library, General Services Administration, Washington, D.C. 20405.

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